

## Factors Influencing to Clinical Outcomes of the Surgically Treated Degenerative Lumbar Spondylolisthesis

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### – Abstract –

**Study design:** To examine the factors considered in the selection of therapeutic methods, and the methods for accessing postoperative clinical outcomes, in degenerative lumbar spondylolisthesis.

**Objectives:** In this retrospective study, patients who had taken only posterolateral fusion, and with a posterior lumbar interbody fusion, were evaluated. The analyses of the pre- and post-operative factors associated with the clinical outcomes of the surgery for degenerative lumbar spondylolisthesis were also performed.

**Materials and Method:** Of the patients who had received the surgery for degenerative lumbar spondylolisthesis, between January 1995 and December 2000, there were 59 for whom follow-up observations were possible, and these were selected for the present study. The patients were comprised of 19 males and 40 females, with ages ranging from 42 to 74 years ( $58.4 \pm 8.4$  years old). Of the 59 patients, 39, and 20, received a posterolateral fusion, or both a posterolateral fusion and a posterior lumbar interbody fusion, respectively. In the present study, the pre-operative factors considered were the surgical method, sex, age, L1 axis S1 distance (LASD), lordosis angle and the degree and duration of spondylolisthesis, with the degree of fusion, the lordosis angle of the fused body, the lordosis angle at the final follow-up and the lordosis angle of the fused body at the final follow-up, used as the post-operative factors. Each factor was statistically tested to see if it had a significant correlation with clinical outcomes (Recovery rate by Hirabayashi's method). A value of  $P < 0.05$  was considered as being statistically significant.

**Result:** The posterolateral fusion group showed a significantly lower recovery rate with an LASD over 35 mm, a degree of spondylolisthesis over 10 mm and a pre-operative lordosis angle under  $20^\circ$ , indicating that an additional posterior lumbar interbody fusion would provide a good clinical outcome. At the final follow-up, both groups showed significantly lower recovery rates with a lumbar lordosis angle under  $20^\circ$ , and the posterolateral fusion group showed significantly lower recovery rates when the post-operative lordosis angle of the fused segment was under  $18^\circ$ , and with a lordosis angle of the fused segment was under  $18^\circ$  at the final follow-up. These post-operative factors showed significant correlations with the clinical outcomes.

**Conclusions:** It is considered that an additional posterior lumbar interbody fusion is indicated in patients with a LASD over 35 mm, an anterior slippage over 10 mm and a lumbar lordosis angle over  $20^\circ$ . It is also considered that the lordosis angles of the fused segment, and the post-operative lumbar lordosis, are important factors that require peri-operative correction and maintenance.

**Key Words:** Degenerative lumbar spondylolisthesis, PLIF, L1 axis S1 distance (LASD)

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59

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가 19

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<sup>14,21)</sup>

33%

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42

74

58.4

(58.4 ± 8.4)

<sup>20)</sup>

4-5

38

(64.4%)가

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,

52

40 (67.8%)가

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(88.1%)

,

50

(84.7%)

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<sup>10,13)</sup>

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20

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Cylindrical Titanium cage

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(L1 axis S1 distance: LASD)

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, LASD가 35 mm

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3.

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39

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(L1 axis

S1 distance, LASD),

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12

15

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3

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(Fig. 1).

Lenke<sup>17)</sup>

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A,

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B,

C,

D

2)

JOA<sup>28)</sup>

JOA

Hirabayashi

12

15

8)

(Table 1).

Recovery rate of Hirabayashi's method

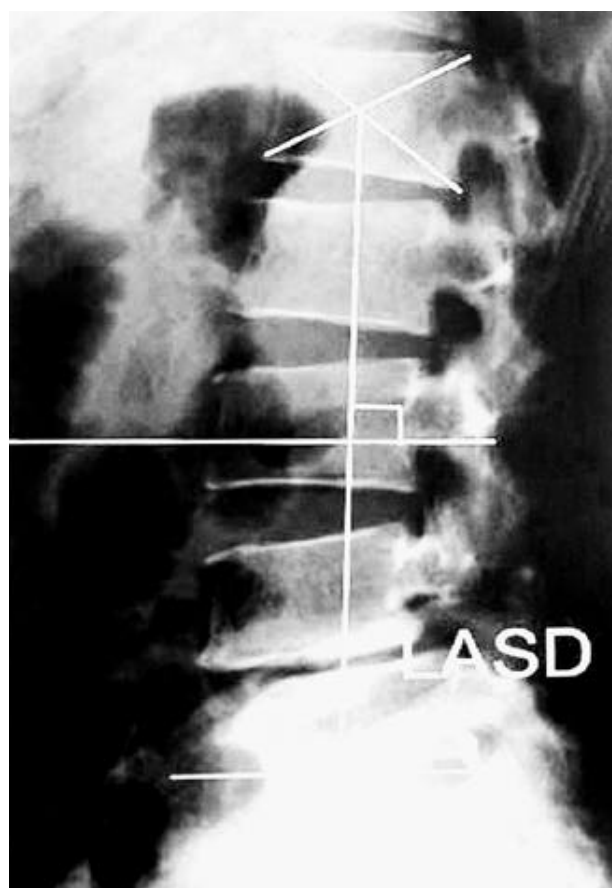
$$= (\text{final JOA score} - \text{preoperative JOA score}) / (29 - \text{preoperative JOA score}) \times 100\%$$

3)

t-

,  $P < 0.05$ 

가



**Fig. 1.** LASD(L1 axis S1 distance) is horizontal distance between L1 axis line that is perpendicular to L3 vertebral body and the back corner of the S1 body.

1. (Table 2)

1)

가 12

, 51.3% (51.3 ± 11.8),

27

, 45.0% (45.0 ± 11.1)

( )

가 7

45.0% (45.0 ± 11.1),

13

60.7% (60.7 ± 13.1)

2)

60 19 ,  
49.8% (49.8 ± 13.0), 60 21 ,  
43.6% (43.6 ± 8.8)

60 11 ,  
67.5% (67.5 ± 8.7), 60 9 ,  
49.0% (49.0 ± 10.4) 60

3) LASD

LASD가 35 mm 28 ,  
50.6% (50.6 ± 11.3), 35 mm 11 ,  
37.6% (37.6 ± 5.0) 35  
( $P < 0.0001$ ). LASD가 35  
mm 9 , 59.9% (59.9 ± 15.4), 35  
mm 11 , 61.9% (61.9 ± 10.9)

4)		5)	
		7± 10 mm	21
	20	11	, 50.8%(50.8 ± 11.7), 10 mm
40.1%(40.1 ± 9.3), 20	28		, 42.4%(42.4 ± 9.8) 10 mm
49.6%(49.6 ± 11.3) 20			(P=0.0221).
(P=0.0188).		7± 10 mm	1
20	7		, 47%, 10 mm
11.5), 20	13		, 61.8%(61.8 ± 12.7)
12.4)			.

**Table 1.** Japanese Orthopaedic Association Scoring System for Treatment of lower Back Pain(JOA Score)

Items			Score
Subjective symptom	Low back pain(3point)	None	3
		Ocassional mild pain	2
		Frequent mild or severe pain	1
		Continuous severe pain	0
	Leg pain and/or tingling(3point)	None	3
		Ocassional mild symptom	2
		Frequent mild or severe symptom	1
	Gate (3point)	Continuous severe symptom	0
		Normal	3
		Able to walk farther than 500 m although in pain tingling and/or muscle weakness	2
		Unable to walk farther than 500 m although in pain tingling and/or muscle weakness	1
Objective symptom	Straight leg raising(2point)	Unable to walk farther than 100 m although in pain tingling and/or muscle weakness	0
		Normal	2
		30-70	1
		Less than 30-70	0
	Sensory abnormality(2point)	Normal	2
		Mild disturbance(not subjective)	1
		Marked disturbance	0
	Mortor disturbance(MMT)(2point)	Normal (Grade5)	2
		Slight weakness (Grade 4)	1
		Marked weakness (Grade 3-0)	0
Restriction of ADL (14point)	Turning over while lying standing		
	Washing	No restriction	2
	Learning forward	Moderate restriction	1
	Sitting(about 1 hour)	Severe restriction	0
	Lifting or holding heavy objects		
Urinary bladder function(-6point)	Walking		
		Normal	0
		Mild dysuria	-3
		Severe dysuria	-6
Total score			29

6)	20	,	51.4%(51.4 ± 10.1)	18
				(P=0.0115).
	30	22	,	18
	49.7%(49.7 ± 12.8), 30	17	9	, 58.1%(58.1 ± 15.8), 18
	43.4%(43.4 ± 8.7)		11	, 63.4%(63.4 ± 9.9)
	30			
12	,	67.2%(67.2 ± 8.8), 30	8	
	,	51.8%(51.8 ± 12.7)	30	3)
		(P=0.0047).		
			20	
2.	(Table 3)	13	,	37.6%(37.6 ± 5.4), 20
		26	,	51.6%(51.6 ± 10.9)
1)				20 (P<0.0001).
			20	3
	Lenke	A 25	, B	39.8%(39.8 ± 4.0), 20
12	, C 2	A 14	, B 6	2 64.8%(64.8 ± 9.7) 20
	B			(P=0.0004).
	52%			
		52%	4)	
		가		
	(P=0.0031).			
		18	23	, 42.2%(42.2 ±
2)		10.6), 18	16	, 53.7%(53.7 ±
		9.4)	18	
		(P=0.0014).		
	19	, 42.3%(42.3 ± 11.3), 18	18	13
			14.1), 18	7
				, 60.2%(60.2 ±
				, 62.5%(62.5 ±

**Table 2.** Recovery rate according to preoperative factors

Factors		Op methods(RR: %)	
		PLF	PLF + PLIF
Sex	male	51.3 ± 11.8(n=12)	45.0 ± 11.1(n=7)
	female	45.0 ± 11.1(n=27)	60.7 ± 13.1(n=13)
Age	< 60	49.8 ± 13.0(n=19)	*67.5 ± 8.7(n=11)
	60	43.6 ± 8.8(n=21)	*49.0 ± 10.4(n=9)
LASD	< 35 mm	*50.6 ± 11.3(n=28)	59.9 ± 15.4(n=9)
	35 mm	*37.6 ± 5.0(n=11)	61.9 ± 10.9(n=11)
†Pre-L	< 20 °	*40.1 ± 9.3(n=11)	54.2 ± 11.5(n=7)
	20 °	*49.6 ± 11.3(n=28)	64.7 ± 12.4(n=13)
Slippage	< 10 mm	*50.8 ± 11.7(n=21)	47(n=1)
	10 mm	*42.4 ± 9.8(n=18)	61.8 ± 12.7(n=19)
Duration	< 30 mo	49.7 ± 12.8(n=22)	*67.2 ± 8.8(n=12)
	30 mo	43.4 ± 8.7(n=17)	*51.8 ± 2.7(n=8)

\* P&lt;0.05

†Pre-L: preoperative lumbar lordosis

10.7)

3. (Table 4)

LASD  
( : -0.4467, P=0.0044) LASD가  
,  
( :  
-0.3949, P=0.0128),  
( :  
0.6797, P<0.0001)  
,  
( : -0.6767,  
P=0.0011),  
( : 0.9482,  
P<0.0001)  
,  
,  
,

**Table 3.** Recovery rate according to postoperative factors

Factors		Op methods(RR: %)	
		PLF	PLF + PLIF
Fused segment lordosis	< 18 °	*42.3 ± 11.3(n=19)	58.1 ± 15.8(n=9)
	18 °	*51.4 ± 10.1(n=20)	63.4 ± 9.9(n=11)
Follow-up fused segment lordosis	< 18 °	*42.2 ± 10.6(n=23)	60.2 ± 14.1(n=13)
	18 °	*53.7 ± 9.4(n=16)	62.5 ± 10.7(n=7)
follow-up lumbar lordosis	< 20 °	*37.6 ± 5.4(n=13)	*39.8 ± 4.0(n=3)
	20 °	*51.6 ± 10.9(n=26)	*64.8 ± 9.7(n=17)

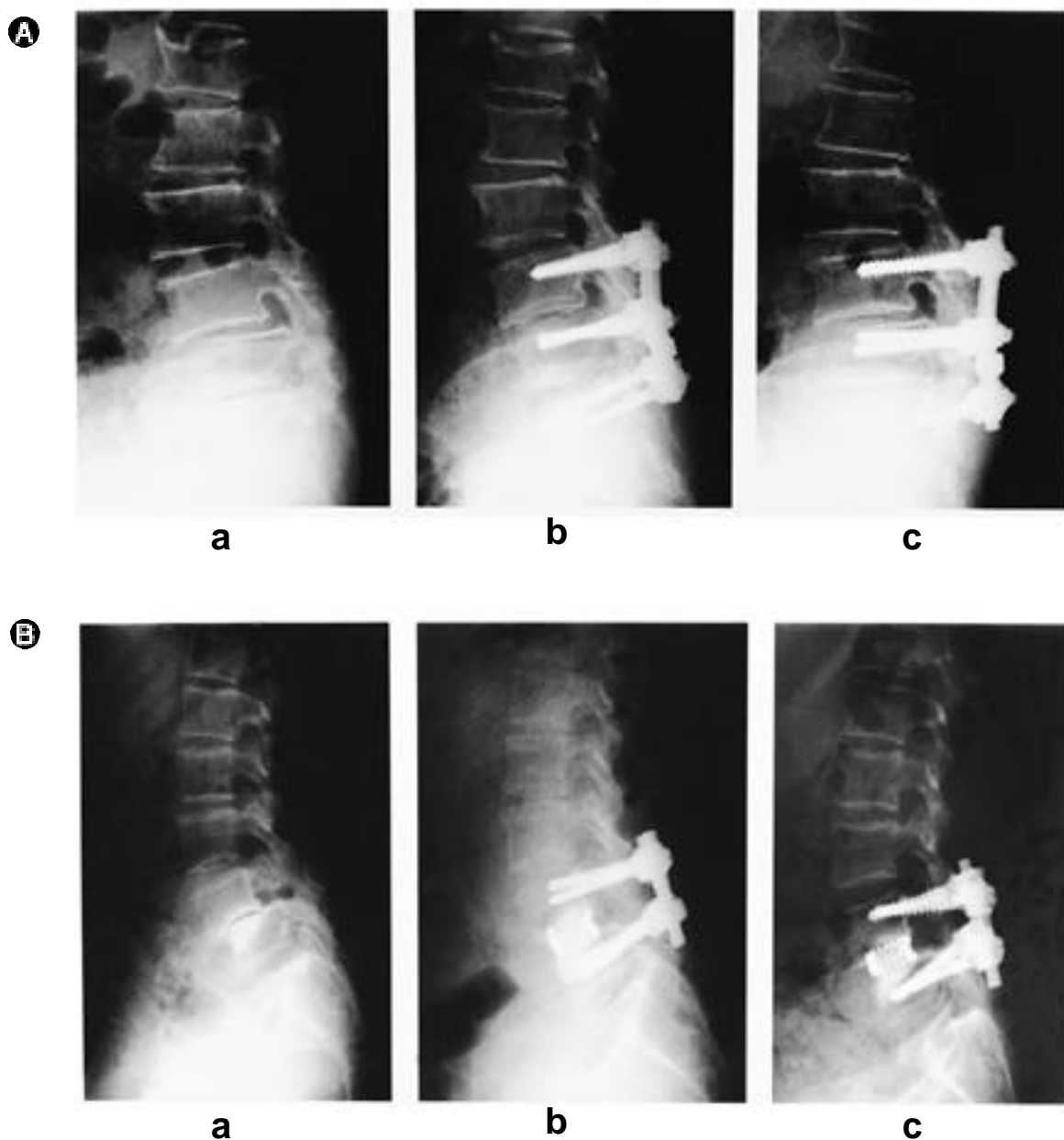
\* P<0.05

**Table 4.** Correlation of factors and recovery rate by Pearson analysis

Factors	C.C in OP	
	PLF	PLF + PLIF
LASD	-0.4467*	-0.2587
Preoperative lumbar lordosis	-0.0282	0.4158
Slippage	-0.2187	0.0622
Duration	-0.3949*	-0.6767*
Fusion rate	0.2156	0.2077
Fused segment lordosis	0.1325	0.1782
Follow-up fused segment lordosis	0.2212	0.1068
Follow-up lumbar lordosis	0.6797*	0.9482*

C.C: a coefficient of correlation

\*P<0.05



**Fig. 2. A.** 65-year-old female patient with degenerative lumbar spondylolisthesis, L4 on L5. **(a)** Lateral view of preoperative plain x-ray. LASD is 35 mm, preoperative lumbar lordosis is 15 degree and anterior slippage of L4 is 10 mm. **(b)** Immediate lateral view of postoperative plain x-ray, treated with posterior decompression and instrumented postero lateral fusion of L3-4-5. Postoperative fused segment lordosis is 10 degree. **(c)** Twelve months follow up lateral view of plain x-ray, shows follow-up lumbar lordosis is 16 degree and follow-up fused segment lordosis is 10 degree. At this point, recovery rate of the patient was 31.5 %.

**B.** 62-year-old female patient with degenerative lumbar spondylolisthesis, L4 on L5. **(a)** Lateral view of preoperative plain x-ray. LASD is 52 mm, preoperative lumbar lordosis is 30 degree and anterior slippage of L4 is 12 mm. **(b)** Immediate lateral view of postoperative plain x-ray, treated with posterior decompression, instrumented posterolateral fusion of L4-5 and posterior lumbar interbody fusion of L4 and L5. Postoperative fused segment lordosis is 5 degree. **(c)** Fourteen months follow up lateral view of plain x-ray, shows follow-up lumbar lordosis is 18 degree and follow-up fused segment lordosis is 5 degree. At this point, recovery rate of the patient was 70.6 %.





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74	(58.4 ± 8.4).	39 ,	20
,	,	1	(LASD),
,	,	,	,
,	,	(Recovery rate by Hirabayashi 's method)	
가	, P<0.05	가	.
:	LASD가 35 mm	가 10 mm	20
가	,	가	
,	20	가	
18	가	18 ,	
:	LASD가 35 mm ,	가 10 mm ,	20 가
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